



TIMOR-LESTE PLASTIC UPCYCLING ALLIANCE

Final Report

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Acronyms

3Rs	Reduce, Reuse & Recycle
ADN	Ajensia Dezenvolvimentu Nasional
APWC	Asia Pacific Waste Consultants
AHDMTL	Associação Halibur Difisiénsia Matanem Timor-Leste
AS/NZS	Joint Australian/ New Zealand standards
ASTM	American Society for Testing and Materials
EU	The European Union
GoTL	Government of the Democratic Republic of Timor-Leste
ESHANA	Student association for the environment UNTL
HDPE	High Density Poly Ethylene
IR	Intermediate Result
KOICA	Korea International Cooperation Agency
LDPE	Low Density Poly Ethylene
LEAF	Leaching Environmental Assessment Framework
MEYS	Ministry of Education Youth and Sports
MC	Mercy Corps
MOU	Memorandum of Understanding
MoPW	Ministry of Public Works
MTCI	Ministry of Tourism Commerce and Industry
PET	Polyethylene terephthalate
PP	Polypropylene
PSA	Plastics Solutions Alliance
PUA	Plastic Upcycling Alliance
R4D	Roads for Development
R&D	Research and Development
SDGs	Sustainable Development Goals
SER	Sentru Estudu Resiklajen
SSE	Secretary of State for the Environment
TFA	Tourism for All
TL	Timor Leste
UNDP	United Nations for Development Programme
UNTL	National University of Timor-Leste
USAID	The United States Agency for International Development
USEPA	United States Environment Protection Agency

Executive Summary

Program Overview: The Plastic Upcycling Alliance (PUA) is a three-year, \$900,000 activity to sustainably address plastic waste management in Timor-Leste. PUA works to address both the challenges of excessive plastic waste and the potential to develop a competitive ‘plastics circular economy’ in Timor-Leste. Mercy Corps, in partnership with USAID, is implementing the activity with leveraged engagement from private sector partners – global brewer Heineken and local civil engineering company Caltech.

PUA aimed to catalyze the growth of the plastics recycling industry, creating and expanding valuable employment and entrepreneurship opportunities with the potential to improve the natural beauty of Timor-Leste and protect the health and safety of its people. **The goal was to advance Timor-Leste towards a ‘plastic neutral’ status whereby unnecessary plastic use is curtailed and replaced and up to 20% of Dili’s plastic waste is collected and recycled into locally sought-after products within three years.** Under this goal were three activity objectives (AOs):

- (1) Reduce Plastic Use;
- (2) Increase Plastic Recycling; and
- (3) Improve Plastics Management.

The technical approach was built on the premise of multi-tiered stakeholder participation in the plastics recycling industry, whereby plastic by-products were collected from businesses and industry actors; waste contractors collect and sell plastic waste from community recycling bins; and waste pickers collect plastic waste directly from households, as well as discarded plastic waste in the community. Once collected, the plastic waste was delivered to aggregators and micro-processors, who aggregate, clean, sort, and/or shred plastics, creating a value-added product for sale onwards to upcyclers. The initiative also worked towards enabling an environment for recycling plastic waste and the vision of collaboration, learning, and adaptation. The program worked closely with the Government of Timor-Leste and local stakeholders to support a policy environment that catalyzes the plastics waste industry while also establishing a model of plastics management for dissemination.

Key Achievements of the Initiatives:

- › **Operationalization of the Plastics Solutions Alliance (PSA):** Mercy Corps facilitated the creation of the Plastics Solutions Alliance (PSA), bringing together three development partners, USAID, the European Union (EU), and the Korea International Cooperation Agency (KOICA), as well as two private sector leads (Heineken Timor-Leste and Caltech) around the shared vision of a plastics-neutral Timor-Leste. The three-year partnership leverages more than US\$3.5 million in private and development funding to tackle Timor-Leste’s plastic waste challenge.
- › **COVID-19 Response Adaptation:** The PSA collectively supported 33 Recycled Plastic Paver demonstration sites/handwashing facilities across Dili, including five from PUA, five from Heineken, and 23 by the EU and KOICA. These demo sites served a dual purpose of promoting recycling and marketing recycled products while also reducing the risk of disease transmission through the provision of handwashing facilities. The sites spurred significant marketing interest, resulting in an additional 41 demo sites ordered by PSA partner Caltech.



- › **Piloting an integrated plastic waste collection system.** In March 2021, Mercy Corps launched the piloting of a private sector-driven plastic waste collection service in Dili. Despite exceptional circumstances during the start-up phase, marked by devastating floods and prolonged COVID-19 restrictions that resulted in the closure of several participating institutions, the service maintained its operations and completed weekly end-to-end collection rounds from each bin to the recycling station.
- › **Expanding engagement with road construction actors.** Road and infrastructure construction is key to creating a market for building materials integrating recycled plastic waste. Therefore, Mercy Corps increased its coordination and advocacy efforts with targeted government stakeholders involved in transport, public works and construction standards to advocate for the introduction of recycled content requirements and the use of plastic asphalt in planned road developments and upgrades.
- › **Analyzing global best practices and connecting with global initiatives.** Mercy Corps led extensive research to analyze global best practices in the development of recycling supply chains and upcycled product lines, with a focus on applicability in Timor-Leste. Through these discussions, Mercy Corps intended to examine how international stakeholders may have tackled some of the market, technical, and regulatory barriers the program was faced with, and to explore opportunities to link PUA's efforts to global markets and coalitions.
- › **Providing ecosystem support to local upcycling actors:** PUA supported a series of initiatives to improve the visibility, marketing, and sales opportunities for local upcycling and recycling businesses. These measures included the development and publication of Timor-Leste's first upcycling catalog, expo-like promotional events, networking events, demonstration projects and activities, and more.
- › **Investing in recycling value chain solutions:** PUA worked in close collaboration with the PSA to catalyze investment toward the creation of Timor-Leste's first commercial-scale recycler. De-risking interventions included the procurement of material testing services to assess the performance of recycled products according to international standards, the hiring of specialized consultants to produce a market and economic analysis of recycling in Timor-Leste, and discussions to fund the purchase and importation of additional recycling equipment to increase processing capacity and expand product lines.
- › **Enhancing dialogue and cross-sector linkages:** PUA organized and participated in several events that brought together government, private sector, development, and civil society stakeholders to share ideas on plastic pollution and recycling. These events aimed at increasing plastic awareness, inspiring policy reform, and influencing demand to support the uptake of recycled products across all sectors of society.
- › **Documenting, communicating, and disseminating PUA's lessons:** Mercy Corps produced and disseminated four collaboration and learning documents among key local and international stakeholders. Rather than mass distribution, PUA focused its dissemination approach on direct, qualitative interaction at in-person events and through bilateral contacts, whereby readers were pre-selected and informed about the documents before dissemination to inform strategic distribution to key stakeholders.

- › **Gaining international recognition and elevating the profile of the PSA:** Mercy Corps was selected through competitive processes to present about the PSA at two international events, the 2022 Concordia Annual Summit and the 7th International Marine Debris Conference (7IMDC). On these occasions, Mercy Corps presented the work of the PSA in front of global audiences and provided unique visibility to PUA's efforts beyond the border of Timor-Leste. As part of the Concordia Annual Summit, the PSA was selected as one of five global finalists for the 2022 P3 Impact Award (which recognizes public-private partnerships (P3s) and was selected out of 100+ partnerships representing 145 countries). In addition, the PSA recycled paver handwashing installation sites were globally recognized for their responsiveness to immediate needs. [Reuters](#), [Mashable](#), and [A-Plus](#) all highlighted the intervention, reaching thousands of global viewers with information about the PSA intervention.



Mercy Corps representing the PSA at 7IMDC (left) and Concordia Annual Summit (right) (Source: Mercy Corps)

Summary of Achievements

Strategic Objectives/ Intermediate Goal	Indicator	Reach to Date	Cumulativ e Target	Reporting Frequenc y	Comments/ Clarification
Aim: Circular economy for plastic waste created and expands employment and entrepreneurship opportunities while protecting the natural beauty of Timor-Leste and health and safety for its people	Number of income-generating opportunities supported in Plastics Circular Economy as a result of the activity's assistance	67	15	Annual	LoP target achieved
Goal: Timor-Leste achieves 'plastic neutral' status whereby plastic use is limited and plastic waste is collected and recycled into locally sought-after products	Quantity (weight) of plastic recycled/upcycled into locally sought-after products as a result of the activity's assistance	38,677 kg	100 tons / 100,000 kg	Annual	Additional machinery to diversify recycled product lines was procured and started operation in April 2023. It is anticipated that the 100-ton target will be reached within two years of operation.
INCREASE PLASTIC RECYCLING					



IR 2.2: Competitive recycled plastics product line developed (R&D)	Number of product lines researched	41	12	Quarterly	LoP target achieved
IR 2.2: Competitive recycled plastics product line developed (R&D)	Number of product lines developed	31	6	Quarterly	LoP target achieved
IR 2.2: Competitive recycled plastics product line developed (R&D)	Number of MSMEs supported <i>Disaggregated by size of the enterprise</i>	15 <i>Micro: 11 Small: 4 Medium: 0</i>	7	Quarterly	LoP target achieved
IR 2.3: Demand for recycled plastic product lines increased	Number of communication platforms used to market upcycled and/or plastic alternative products	11	8	Quarterly	LoP target achieved
IR 2.4: Distribution channels and installation services for recycled plastic product lines developed	Number of demonstrations promoted	21	8	Quarterly	LoP target achieved
IMPROVE PLASTICS MANAGEMENT					
IR 3.1: Policy enabling environment for plastics reduction and recycling improved	Number of dialogues between government and sector stakeholders regarding plastics reduction and improved recycling	16	20	Quarterly	LoP target was not achieved. COVID-19 restrictions caused the cancellation of several dialogue events, whereby the project had to combine several dialogue events when the restrictions were lifted. Hence, the total number of events is less than the target.
IR 3.1: Policy enabling environment for plastics reduction and recycling improved	Number of strategies for a policy enabling environment regarding polymer-enhanced road construction created and disseminated	0	1	Quarterly	LoP target was not achieved. The activity engaged with the government, but concrete action plans regarding road construction could not be agreed upon. A general policy recommendation for reducing plastic usage has been developed and disseminated.

IR 3.2: Evidence of impact produced	Number of collaboration, learning, and adaptation documents created	7	6	Quarterly	LoP target achieved
IR 3.3: Model of plastics management in small to medium-sized cities produced					
IR 3.4: Evidence and lessons disseminated	Number of collaboration, learning, and adaptation documents disseminated	6	6	Quarterly	LoP target achieved
IR 3.4: Evidence and lessons disseminated	Number of participants attending collaboration, learning, and adaptation events where information disseminated	78	70	Quarterly	LoP target achieved

Note: IR 1.1 to IR 2.1 fall under KOICA activities – in line with the MEL Plan, indicators listed here focus only on PUA activities.

Phase 1

The first year of implementation encompassed a start-up phase and implementation of the first half of program Phase 1 (where Phase 1 was an 18-month period). While the start-up phase was foundationally considered important, in the context of the collaborative nature of the PSA, it was even more critical to take a consensus-building approach that focused on shared goals and integrated systems. During this phase of implementation, Mercy Corps held kick off meetings with the United States Embassy, ensuring the Mission Director was briefed on program interventions. In addition, the team strengthened relationships with key stakeholders within the Government of Timor-Leste (GoTL), including the Secretary of State for the Environment (SSE), the Ministry of State Administration, the National Department for Bridges, Roads and Flood Control under the Ministry of Public Works, and Dili Municipality. Through these efforts, the team established a Memorandum of Understanding (MOU) with SSE as the lead government partner for the activity.

Mercy Corps also operationalized the PSA by bringing together its three development partners, USAID, the EU, and KOICA, as well as two private sector leads (Heineken Timor-Leste and Caltech) with an MOU signing ceremony in November 2019. During the start-up, which required close coordination, the PSA met monthly. To ensure close coordination, Mercy Corps facilitated monthly meetings with PSA partners. During these meetings, updates from different partners were discussed, activities were reviewed, and strategic directions were agreed upon. After a year of implementation, the PSA agreed to split into two governing bodies: the Steering Committee, which was to meet on a monthly basis for day-to-day coordination; and the Executive Committee, which met quarterly starting in Year 2 for strategic discussions. After convening their partnership during PUA's first year of work, PSA-founding partners KOICA, Heineken Timor-Leste, Caltech, USAID, and Mercy Corps formalized their collaboration with the EU and completed the EU's integration into the alliance through the signing of a joint Terms of Reference in January 2021. With this addition, the partnership leveraged

more than \$3.5 million in private and development funding to work toward the achievement of a shared vision of a plastic-neutral Timor-Leste.

Following start-up, the team successfully transitioned to the implementation of Phase 1 (first 18 months) of the program. Phase 1 of the program focused on a “pilot and certify” approach in which the program scaled up to establish the first commercial-scale plastics recycling and introduced products made from plastic recycled within Timor-Leste.

Transition from Phase 1 to Phase 2

After a first year dedicated to start-up activities and the commencement of program Phase 1 (Pilot and Certify), the second and third years of implementation enabled PUA to initiate the transition towards program Phase 2 (Grow, Scale, Document and Replicate). During Year 2 and Year 3, the team activated select Phase 2 priorities for the most advanced components of the program, while continuing to drive strategic initiatives to accelerate the roll-out of Phase 1 activities that experienced some delays.

This combined approach allowed PUA to consolidate its foundations, refine its perspective, and advance its agenda, while constantly cultivating its collaborative nature and focusing on consensus-building and integrated systems. PUA ramped up its efforts through a series of mutually reinforcing, interrelated activities: prototype and test new product lines; promote the products of local businesses engaged in plastic upcycling; pilot a new plastic waste collection system; initiate a market and economic analysis assessing the replicability of global best practice in the development of plastic recycling value chains; conduct exploratory consumer research to understand key motivators, barriers, and market potential for recycled products; and establish connections with global movements, initiatives and experts in the plastic world.

PUA also intensified its engagement with relevant government stakeholders, recognizing that government participation is key to improving plastic waste management and to creating an enabling environment for recycling. Mercy Corps continued to expand its coordination with key government bodies in order to explore opportunities for support between PUA’s activities and existing institutional efforts. Several collaboration ideas using different platforms (e.g., business and trade events, new product promotion, international conventions, awareness and behavior change campaigns, environmental education, etc.) were discussed to stimulate demand for upcycled plastic products and non-plastic alternatives.

Note: IR 1.1 to IR 2.1 fall under KOICA activities – The narrative below highlights activities funded by PUA.

Objective 2 – Increase Plastic Recycling

New Product Development - Prototyping and Testing Products Lines

PUA worked closely with PSA partner Caltech and local businesses to support their R&D activities on new plastic recycling processes and product ideas. 41 different products were tested and prototyped out of which 31 of them were developed and commercialized. For details on the products available in the market see table below.

Name of private sector partner	Product Type	Number of products available in the market
Caltech	Paver, footprint, tactile pavers, and curbstone	4
Husi Rural Sai Global	Brick	1
AHDMTL	'Plastic feather' duster, vase, flowers, earrings, Decorative flower made from foam net wrapper, Flip Flop, Door Mat, Basket made from plastic cups	8
Tiwomen Ecojewelry	Jewelry made from ironed plastic bags, Crochet earring, Bags from used banner, Earing Cone, Key Chain from HDPE Plastic, Bags from unused banner, Earing Beats from Plastic bags	7
Klibur Badaen Tradisional Ale-ale Timor	Drawing storage tube, Floor mat, Belt, Pencil Case, Water bottle holder, cups with glass cover	6
Sentru Estudu Resiklajen (SER)	Broach, Portrait drawing from LDPE, Stationary Holder, Bracelet, Headband/flower crown	5

Introducing New Upcycling Technologies

On its journey to create Timor-Leste's first commercial-scale recycler, the PSA focused first on increasing Caltech's shredding capacity to address storage constraints that limited the collection of recyclables (system commissioned in February 2022). Achieving commercial-scale operations also required new extruders and presses to replace Caltech's existing manual equipment and improve its ability to transform pre-processed materials into new products which were commissioned April 2023.

To further expand the types of waste that can be reprocessed locally and diversify the product lines that can be manufactured onsite, Caltech further invested in a new machine that can turn low value waste into a wide range of items with multiple applications. This equipment will fabricate plastic-based plywood-like panels and chipboards from multi-layer packaging materials that are usually considered extremely challenging to convert because they combine plastic (usually polyethylene) with other materials like aluminum foil or paper (toothpaste tubes, food wrappers and sachets, Tetra Pak cartons, etc.)

Plastic Asphalt Research and Advocacy

Building on its collaboration with the National University of Timor-Leste (UNTL) initiated during Year 1, PUA supported new research in the field of plastic asphalt mixes. While the first phase of UNTL's research focused on the use of PET as a binder in bitumen-free mixes, this second stage aimed at broadening the scope of the tests to study the properties of asphalt mixes that incorporated various types of plastic waste, as widely seen in other countries. With support from PUA partners Caltech and Verde, Mercy Corps coordinated the shredding and the delivery of 25kg of HDPE, 25kg of LDPE, 25kg of PET, and 12kg of PP that were used for these new tests. In parallel, PUA opened discussions with the UNTL Dean's office to assess the feasibility of implementing a demonstration project using plastic asphalt and recycled plastic construction materials on UNTL's campus in Hera. Targeted consultations were held with the Ministry of Public Works, the Ministry of State Administration via the Dili Municipality, and the road construction verification team of the Ajensia Dezenvolvimentu Nasional (ADN) to inform their representatives about these new materials, and to discuss the feasibility of piloting the use of plastic asphalt in ongoing or future road paving projects. Repeated competitive tenders issued by Mercy Corps for procuring road paving services incorporating plastic waste were unsuccessful. The conclusion of multiple bilateral engagements with local actors and consultations with international stakeholders indicate that the expertise required in the country is limited, and the cost of such a project is higher than initially estimated. The recommendation for future programming is to create ownership and interest within relevant government agencies and to initiate a pilot using international expertise.

Demonstration Projects

As part of their collaboration to promote the circular economy, Mercy Corps and the Ministry of Tourism, Commerce and Industry (MTCI) worked with the Municipality of Dili to implement the first demonstration project showcasing the use of locally produced eco-construction materials in the capital city's public space. The selected site included a pedestrian recreation area around the city's lighthouse – one of Dili's most-visited monuments.

More than 3,400 pavers and curbstones made from recycled waste were fabricated and installed by local construction company Caltech to complete the site's makeover, using the equivalent of 297,637 discarded plastic bottles. Intended to increase awareness of plastic issues and encourage the uptake of locally recycled products, the initiative was part of a collective effort to transition to responsible plastic use, combining civil society participation, behavior change, investment in local circular solutions, and diversified ecosystem support to build an inclusive value chain.

As plastic pollution emerges as a key challenge to achieve Timor-Leste's vision to become a competitive tourism destination, respectful of its natural beauty and cultural heritage, the project highlighted the importance of cross-sector cooperation to address the country's growing stream of plastic. The project was commissioned on November 9th, 2022, with all supporting partners present.

To build on the momentum created by the ceremony, the event included an interactive Q&A session between Caltech, Mercy Corps, and all attending guests that offered a platform to promote Caltech's new recycled product lines and encourage dialogue between government, civil society, businesses, and development partners involved in driving change on plastic issues.



Commissioning of the demonstration installation at Dili Lighthouse (Source: Mercy Corps)



Stakeholder dialogue during the commissioning of the demonstration installation at Dili Lighthouse (Source: Mercy Corps)

Mercy Corps and the Ministry of Tourism, Commerce and Industry worked with the Municipality of Dili and continued their partnership by completing the second demonstration project for recycling pavers at President BJ Habibie Park at Lecidere, Dili. More than 2,200 recycled pavers and curbstones, using the equivalent of 201,115 discarded plastic bottles, were fabricated and installed to rehabilitate the pedestrian recreation area around President BJ Habibie Park. The site was commissioned in February 2022.



President BJ Habibie Demonstration Site Launching Event (Source: Mercy Corps)

Supporting and Promoting Local Upcycled and Plastic Alternative Products

Mercy Corps worked in partnership with UNDP's Integrated Waste Management Program to collaborate on a Social Business Camp Training, a multi-day training event attended by local recycling and upcycling business participants, including five businesses supported by Mercy Corps through PUA. The training focused on business management tools and business development strategies, to support upcycled and plastic alternative businesses. It used a business model canvas where participants learned about the different building blocks of a business model, such as defining key partners, identifying business activities to support their value proposition, identifying potential customers, managing relationships with customers, and more. At the end of the training the businesses were offered the opportunity to present a viable business idea to solicit further support from PUA. In addition to the skills and experience, the training also offered rare networking opportunities to meet other upcycling entrepreneurs and learn from each other's experiences, challenges, and successes.

Plastic Waste Collection Pilot

Upstream collection is a critical component to improving plastic waste management. Through its circular economy programming, Mercy Corps has therefore initiated the piloting of a private sector-driven collection service to test the feasibility and economic viability of differentiated collection. Collection is performed by Verde Recycle Ltd. (Verde), a designated service provider selected by Mercy Corps. Since plastic recycling remains new to communities in Timor-Leste, Mercy Corps opted for a progressive approach that includes a temporary subsidy mechanism to support early adopters. During this initial phase, the program covers the additional cost related to the new system and gives participants the opportunity to test the service prior to making any firm financial commitment. The objective is to reach a point where participants agree to pay the service provider themselves after the first 6 months.

The pilot began on March 1, 2021, with 34 recycling bins installed at 25 participating institutions (2 clinics, 5 schools, 2 universities, 6 restaurants, 1 hotel, 2 malls, and 7 residential compounds), and with a target to rapidly reach 50 recycling bins. However, the introduction of mandatory confinement measures in Dili from March until June 2021 did not allow Mercy Corps to complete this initial deployment as planned. Installations resumed in July 2021 and were completed in August 2021 with the delivery of 16 additional bins to achieve the total initially envisaged. Between March 2021 and March 2022, PUA provided gradually decreasing subsidies to support early adopters and guarantee a minimum revenue stream to the private operator in the early stages of the service. Despite this initial support, the service provider did not achieve financial viability and had to suspend operations when the subsidies stopped after 12 months due to high operational costs and an insufficient customer base.

Highlighted key lessons learned include :

Public perception exacerbates the collection financing gap: In Dili, this challenge is exacerbated by the perception that waste collection is a “public service” and should be provided for free. Most households and institutions do not pay for any waste management services and dispose of their waste, including plastic waste, in community bins placed on the roadside and public spaces, which do not require any waste separation and

do not cost anything. Private contractors provide collection services for a fee to a minority of private businesses and government agencies. Unless market conditions and perceptions change, this challenge is expected to drastically limit the potential of any new collection scheme, and the revenue required to make the system sustainable in the long run.

Separation at source is perceived as impractical: The second key barrier to adoption was the notion that waste separation at source creates an additional burden for workers, requires training, and mobilizes additional resources, thus creating a disadvantage for participating institutions. Despite the enactment of Timor-Leste's "Zero Plastic" policy more than a year ago, many institutions still indicated through stakeholder and partner consultations that they would refuse to start separating their plastic waste for recycling unless it became mandatory by law. The level of governance by national and municipal authorities will thus be critical in the establishment of viable differentiated waste collection mechanisms for plastic and other low-value recyclables.

Do not focus exclusively on plastic: Environmentally conscious institutions who participated in the pilot expressed the view that the system would be more attractive if differentiated collection efforts were expanded to other recyclables and suggested to install several recycling bins at each location to enable further separation of paper/cardboard, cans/tins, and glass. At an individual level, accommodating such requests would contribute to empowering early adopters who are a driving force to influence their peers and turn a larger audience into agents of change. At an institutional level, this type of comprehensive separation at source would, as seen above, likely appeal to a very small minority of discerning users. To minimize the burden of separation, an alternative approach could consist in collecting all recyclables from a unique bin. Households and institutions would only need to separate recyclables from the rest of their waste and sorting would then be performed either by the collector or the recycler.

Market and Economic Analysis - Consumer Insights and Market Potential

Through a competitive international tender run by Mercy Corps, PUA appointed a specialized consortium comprising Eunomia Research and Consulting Ltd. (Eunomia) and Asia Pacific Waste Consultants (APWC) to perform a dedicated market and economic analysis for developing upcycled/recycled plastic supply chains and product lines. The purpose of this study is to analyze global lessons, identify promising solutions that could offer locally or internationally led investment opportunities in Timor-Leste, and develop evidence-based, simplified business models to support these potential investments. This research shaped PUA's material and product development strategy; informed value chain actors to implement viable business approaches; supported policymakers to create the enabling conditions needed for the market to thrive; and investigated further potential subsidy or cost-share mechanisms that PUA could contemplate to mitigate early project development risks for the private sector.

In August 2021, PUA conducted a series of key informant interviews around Dili to document the preferences and perspectives of local consumers regarding upcycled and recycled plastic goods in general, and Caltech's recycled pavers in particular. The survey was established in coordination with an internal assessment led by Caltech between March and May 2021 among its staff and existing customers. The goal of this research was to gather insights from potential customers to complement Caltech's internal analysis, and to provide an early benchmark of Timor-Leste's market potential for recycled plastic products. To achieve that, PUA followed a

qualitative, exploratory approach, which intended to play a role as a precursor to (and, in the context of prolonged COVID-19 restrictions, an early substitute for) future quantitative research (larger-scale surveys and in-market testing). This research forms part of PUA's action to empower private sector actors engaged in developing innovative plastic recycling solutions and is meant to help existing and potential recycled goods companies challenge, refine, or validate their thinking about market and customer discovery, product offerings and marketing strategies.

Publication of First Upcycling and Recycling Catalog

On May 12, 2022, Mercy Corps and the Ministry of Tourism, Commerce, and Industry (MTCI) announced the release of Timor-Leste's first catalog dedicated to locally made upcycled and recycled products. On this occasion, Dili's Centro de Informação Turística was transformed into an exhibition and networking space for a dozen upcyclers and recyclers, who were able to interact directly with the event participants and market their creations. By explicitly associating recycling with tourism, the launch event emphasized that resource recovery systems have a crucial role to play in supporting Timor-Leste's vision to become a recognized tourism destination, respectful of its natural beauty and cultural heritage. Designed to increase the visibility and desirability of recycled products, and to facilitate sales and purchase inquiries, the catalog included photos, key specifications, and contact information of designers/manufacturers. Its publication with support from the Plastics Solutions Alliance (PSA) aligned with PUA's action in empowering communities to prevent plastic pollution and helping local enterprises build innovative businesses. Its formal endorsement by the national government is an example of cross-sector initiative that can inspire entrepreneurship vocations, stimulate supply and demand for recycled content, and connect local upcycling and recycling groups with new clients, to ultimately make it more economically feasible to collect, sort, and reprocess materials in Timor-Leste.



Recycled product catalog launch (Source: Mercy Corps)



Marketing Events for Upcycled Products

For two consecutive years, PUA partnered with local civil society organization Alola Foundation to offer training and marketing opportunities to upcycling entrepreneurs. In December 2021, PUA teamed up with Alola to support another edition of its annual Christmas fair. To promote improved plastic management during the event, PUA facilitated the presence of seven local upcycling and recycling businesses that create products from plastic waste and alternatives to single-use plastic. In the days leading to the fair, PUA facilitated two training sessions, where eight facilitators presented their plastic recycling techniques to 13 participants, who



learned to fabricate unique handcrafted earrings and flowers from used plastic bags. During the fair, the businesses and innovators supported by Mercy Corps had the opportunity to showcase their skills, market their products, and sell them directly to the public. Participating upcycling businesses included: Mr. Creative, Klibur Badaen Tradisional Homan Ale-Ale Timor, Conservation of Environment Timor-Leste, Sentru Estudu Resiklajen, Asosiasaun Halibur Deficiente Matan Timor-Leste, Hadadin Group, and Tiwomen Ecojewelry. With cumulative sales exceeding \$650 USD, most of these businesses successfully increased their revenue and expressed appreciation for the opportunity to effectively engage with new customers.



Upcycling entrepreneurs attending the Alola fair and training workshop (Source: Mercy Corps)

Material Testing Services

In the last quarter of 2021, PUA appointed ALS Global, an accredited material testing laboratory, to assess the physical and environmental performance of the recycled pavers developed and produced by PSA member Caltech. To maximize future commercial opportunities and specify suitable applications, the pavers were tested according to a set of widely recognized standards. Although standards theoretically operate globally and can be consulted worldwide, PUA opted for norms from New Zealand and Australia, which tend to be more common in the Asia Pacific region, and from the United States, which generally serve as reference on international markets.

- Australia/New Zealand:
 - AS/NZS 4456 for compression, water absorption, moisture, unit mass, and density (no freeze/thaw code in AS/NZS series).
- United States:
 - ASTM C140 for compression, water absorption, unit mass, density, moisture, and freeze/thaw properties (ASTM C67).
 - LEAF Method 1315 (USEPA 1315/1310) for polychlorinated biphenyls and volatile and semi-volatile organic compounds (including polycyclic aromatic hydrocarbons).

The AS/NZS and ASTM tests were completed in March 2022, while the LEAF tests, which evaluate the leaching of hazardous substances in the environment and require longer protocols to simulate aging/erosion, were completed in May 2022. Both test series concluded that the recycled pavers did not present any deficit in terms of physical or environmental performance, nor any characteristics that would limit their wider commercialization. Considering these findings, Caltech expressed reasonable optimism that these results would help convert some of their discussions with prospective buyers overseas into actual deals to initiate international distribution.

Objective 3 – Improve Plastics Management

Linkage with the Tourism Sector

Since January 2021, Mercy Corps, USAID, and Chemonics have been working together to examine how PUA and the Tourism for All (TFA) program could join forces on selected initiatives and achieve more coordinated engagement with government and civil society stakeholders. United around the shared vision of a greener Timor-Leste, TFA and PUA have started to collaborate on the promotion and strengthening of environmental education in Dili. TFA and PUA held a series of joint meetings with the Canossa Institution, the National Directorate for School Social Action at the Ministry of Education, Youth and Sports (MEYS), and the National Directorate for Environmental Knowledge and Information Sharing Center at the Secretary of State for the Environment (SSE) to prepare the organization of a Green School workshop that will highlight 3R (Reduce, Reuse, Recycle) practices. In parallel, Mercy Corps and the Ministry of Tourism, Commerce, and Industry (MTCI) have finalized the drafting of a MOU defining the nature and extent of their proposed cooperation on the circular economy, with a focus on supporting local businesses and stimulating market demand for upcycled and recycled products. Mercy Corps and the Ministry of Tourism, Commerce, and Industry (MTCI) signed a MoU in December 2021 with an overall objective to work collaboratively to address plastics issues.

Analyzing Best Practice and Connecting with Global Initiatives

Since January 2021, Mercy Corps has commenced extensive research to analyze global best practices in the development of recycling value chains, with a focus on applicability in Timor-Leste. Through consultations with selected industry players, experts, and international organizations active in the post-consumer and ocean plastic field, Mercy Corps refined its knowledge and vision of plastics management in small to medium urban settings. Over the past nine months, Mercy Corps has shared its ideas and expertise with more than a dozen specialized institutions including: Circulate Capital, Second Muse, The Incubation Network, Systemiq (Project STOP), Making Oceans Plastic Free, WORK, USAID (Green Cities Division), Audia Elastomer, Heng Hiap Industries, Swire (China Navigation Company), Earthwake, RecycleGO, Plastic Bank, Common Seas, and many more qualified professionals. Moving forward, these outreach efforts are also expected to provide a robust launchpad to successfully disseminate and communicate PUA's lessons learned.

Policy Advocacy and Government Engagement

Mercy Corps liaised to manage government relations on behalf of PUA. Key government bodies included the Secretary of State for the Environment (SSE), Ministry of Tourism, Commerce, and Industry (MTCI) and Ministry of Education, Youth and Sports (MEYS), among others. Following the establishment of a MOU with SSE in Year 1, and the slowdown linked to the State of Emergency in Year 2, Mercy Corps finalized two additional strategic cooperations with MTCI and MEYS during Year 3.

In December 2021, Mercy Corps signed an MOU with MTCI to support local businesses associated with the circular economy and to stimulate market demand for upcycled and recycled products. The execution of the MOU enabled PUA to further connect its action to national socio-economic goals, particularly in the tourism sector. Focused on addressing the problem of mismanaged plastic waste harming the country's environment to create economic opportunities, the cooperation facilitated government participation in cross-sector dialogue, endorsement of promotional events, and provided a framework for the execution of the first demonstration project using recycled products at Dili's lighthouse.

In January 2022, Mercy Corps similarly entered joint Terms of Reference (TORs) with MEYS to strengthen the integration of plastic awareness in education, promote dialogue between SSE, MEYS, and local civil society organizations (CSOs), and implement environmental and plastic awareness campaign events for an initial group of pilot schools.

Cross-Sector Dialogue and Linkages

In June 2022, with support from the PSA, PUA co-organized Timor-Leste's first "World Environment Day Festival" to celebrate the change makers who are paving the way for responsible plastic use and inclusive recycling in Timor-Leste.

On June 3, the opening day of the festival was dedicated to cross-sector dialogue between government, businesses, and civil society. Through a series of forum discussions and networking activities, participants had the opportunity to connect, share ideas and experiences, and explore 3R approaches that could help address the growing challenge of plastic waste in Timor-Leste. The festival continued throughout the weekend (June 4-5) in the gardens of Fundação Oriente, Dili, where visitors discovered a recycling and upcycling market

gathering local talent, artists, and entrepreneurs, in a space bustling with live music, theater, poetry, visual art, and many more creative surprises to raise awareness on plastic pollution. 19 businesses and social enterprises took advantage of these two days to showcase their creations, hold live product demonstrations, and interact directly with clients.

Designed in collaboration with Dili Municipality, national government, and PSA partners, the festival highlighted the importance of empowering citizens and driving the emergence of environmental advocates who can become agents of change within their households and communities. It formed part of a series of events and initiatives aimed at collectively creating opportunities and linkages for local upcycling and recycling groups, who often lack exposure, access to partners, technology, and spaces to sell their products. Over the three days, the festival provided a platform to increase visibility and demand for recycled materials and technologies. In August 2022, Mercy Corps facilitated the visit of a high-level delegation from the Dili Municipality to Caltech's recycling facility. The objective of this activity was to promote dialogue and generate direct interaction between government and private sector stakeholders.



World Environment Day Festival – Day 2-3 (Source: Mercy Corps)

More generally, Caltech and Mercy Corps joined forces to organize more frequent tours of the recycling facility for interested government, private sector, and civil society stakeholders to ramp up marketing and awareness efforts. In addition to the Municipality, visitors this quarter included delegations from USAID, SANTOS, UNDP, VINCI Energies, and ESHANA (UNTL's student association for the environment). A few days after the visit, PUA supported the participation of three local upcycling businesses (Tiwomen Ecojewelry, Sentru Estudu Resiklajen, and Klibur Badaen Tradisional Homan Ale-Ale Timor) in the annual celebrations organized by the Municipality to commemorate the National Popular Consultation (30 de Agostu – Konsulta Popular). The event included a 5-day expo-like fair, where the businesses had the opportunity to present their work, display their products and interact directly with visitors, including representatives from key government bodies, such as the President of Timor-Leste, Ministry of State Administration, Ministry of Social Solidarity and Inclusion, Ministry of Agriculture, Dili Municipality, and more.



Municipality of Dili visiting Caltech recycling facility (Source: Mercy Corps)

A full list of PUA facilitated dialogue and linkage events include:

- October 22, 2019: Coordination meeting on plastic asphalt additive research between Mercy Corps, UNTL/Civil Engineering Department and MoPW
- November 4, 2019: Discussion on use of plastic waste in road construction between Mercy Corps, R4D and MoPW
- March 2, 2020: Plastic asphalt additive research disseminated and discussion for the next steps/research between Mercy Corps, UNTL, R4D and MoPW
- June 5, 2020: Introduction of Caltech machinery to Government (SSE, Ministry of State Administration and Dili Municipality)
- August 17, 2020: Presentation on plastic bank idea/approach to SSE team
- September 23, 2020: Follow-up session on the plastic bank idea between Mercy Corps and SSE team
- September 30, 2020: Discussion on 3R (reduce, reuse and recycle) awareness between SSE and Mercy Corps
- October 28, 2020: Second Follow-up session on the plastic bank idea between Mercy Corps and SSE team
- December 16, 2021: Mini-expo at MoU signature between Mercy Corps MTCI where CSO/plastic recycling business showcasing their products and connecting with government representatives and development partners attending the event (MTCI, SSE, CSOs, businesses, development partners)
- May 12, 2022: Product catalog launch (SSE, Dili Municipality, MTCL, CSOs, businesses, development partners)
- June 3, 2022: Dialogue on Plastic Recycling on opening day of World Environment Day Festival (SSE, Dili Municipality, MTCL, CSOs, businesses, development partners)
- August 26, 2022: Caltech recycling facility visit by Dili Municipality's Administrator and delegation
- August 30, 2022: Participation of upcycling businesses in the 5-day expo organized by Dili Municipality for National Popular Consultation celebration
- November 9, 2022: Commissioning of Farol Demonstration Project at Farol Lighthouse Dili
- November 19, 2022: Plastic Upcycling Alliance (PUA) participation during U.S. Mission Expo at Timor-Plaza
- February 16, 2023: Plastic Upcycling Alliance Project close out

Documentation, Communication, and Dissemination

PUA developed three key research and learning documents:

- Plastic upcycling market and economic analysis: literature scan and landscape analysis (APWC, Eunomia, Mercy Corps, January 2022).
- Market and value chain analysis for post-consumer plastics (APWC, Eunomia, Mercy Corps, March 2022).
- Market and economic analysis for post-consumer plastic: policy recommendations and business opportunities (APWC, Eunomia, Mercy Corps, June 2022).

These documents were disseminated both virtually and physically. Physical dissemination was conducted in all of the project facilitated events during the last year of the project including the U.S. Mission Expo and Night Market organized on November 19th, 2022, to mark the 20th anniversary of U.S.-Timor-Leste diplomatic relations.

PUA Close-out Event

In February 2023, to mark the recycling and upcycling products innovation from recycling and upcycling enterprises, the Plastic Upcycling Alliance Program celebrated the achievement together with Ministry of Tourism, Commerce and Industry, Secretary of State for the Environment, the Municipality of Dili, Heineken, Caltech, Mercy Corps, and all key actors.

13 recycling and upcycling businesses took part in this celebration to encourage the use of recycling and upcycling products and reduce the use of plastic and had the chance to market their products and interact directly with the potential customer through a half day expo at the court center of Timor Plaza.

This event is also dedicated to the collective effort of development partners, Government, Civil Society Organization and the recycling and upcycling business to reduce plastic waste and advance recycling technology in Timor-Leste.



Visitors engaging with plastic upcycling/recycling businesses during the PUA Close-out Event (left) PUA partners group photo (right) (Source: Mercy Corps)

Challenges and Lessons Learned

- › **Protracted COVID-19 restrictions and State of Emergency:** The repeated extensions of mandatory confinement and sanitary fence measures in Dili led Mercy Corps to shut down its office between March and June 2021, and again in August 2021. All field activities in Dili were suspended and PUA had to operate entirely remotely. Whenever possible, the program switched to virtual methods to maintain relationships among co-workers and coordination with partners. However, the prolonged lack of in-person engagement inevitably impacted the line of communication with external stakeholders, especially with government departments where technology fluency remains extremely low. PUA experienced some delays in data collection as well as government liaison and endorsement, which are central to creating an enabling environment and favorable market conditions for recycling and circular models. From a socioeconomic perspective, the restrictions linked to the rise of COVID-19 also made the public less receptive to environmental considerations and have severely affected PUA's core target market for recycled products and materials (hospitality industry, high-income clients willing to invest in landscaping projects, discerning consumers inclined to spend more on eco-friendly products, etc.). PUA remobilized as soon as the restrictions were lifted to re-engage with project stakeholders and partners to ensure project objectives were met.
- › **Lack of access to infrastructure, equipment, and skills for businesses:** Through PUA's monitoring activities, the majority of businesses supported by the program stated that they did not have access to the equipment and facilities to manufacture, display and sell their products regularly. Most organizations also reported a chronic lack of access to management and technical skills. To address this issue, PUA provided basic technical and business training and leveraged funding from other Mercy Corps donors to provide business grants to selected local businesses.
- › **Fragmented market for plastic products:** Since recycling is still a new concept among the population, many Timorese have not been exposed to plastic upcycled and recycled products. Therefore, few people understand the extent of products available and the market demand for plastic recycled products remains highly fragmented, which makes it difficult for businesses to identify a stable customer base and sustain their business.
- › **System-wide policy reform appears:** In the absence of a legal/regulatory framework (e.g., construction standards, building code, etc.), achieving system-wide changes to introduce new public procurement rules across the board may not be possible to stimulate demand for recycled construction materials. At a more finite level, the development of working relationships with particular government bodies (MTCI, MEYS, SSE, Dili Municipality), in order to implement specific projects, offered the most promising path to encourage early adoption, create an appetite for future recycled content requirements, and ultimately reach high-level agreements.
- › **Creation of trash-for-cash system:** Field realities showed that the PSA's initial vision of having waste collectors going around Dili and being paid to gather plastic may not be viable. Firstly, because Caltech is already a waste collector and waste management service provider who has access to free plastic waste and the potential for further scale-up with the creation of additional voluntary drop-off points. Caltech's existing setup, therefore, looks sufficient to ensure a steady supply of plastic waste in the short- medium-term, thereby limiting the need to incentivize the collection and organization of waste pickers. Secondly,

because the economics of recycling and the real cost of the circular economy remains largely misunderstood, there remains little incentive in creating a new system of waste collection. Potential clients are reluctant to pay more for recycling because they focus on the recycler's potential revenue from future products without looking at the associated cost of the collect-sort-transport-recycle process.

- › **Plastic Waste collection lessons learned:** Upstream collection is a critical component to improve plastic waste management. Through its circular economy programming, Mercy Corps piloted a private sector-driven collection service to test the feasibility and economic viability of differentiated collection for recyclables. Between March 2021 and March 2022, PUA provided gradually decreasing subsidies to support early adopters and guarantee a minimum revenue stream to the private operator in the early stages of the service. Despite this initial support, the service provider did not achieve financial viability and had to suspend operations when the subsidies stopped after 12 months due to high operational costs and an insufficient customer basis. As part of PUA's efforts to document its model and recommendations for plastic management, the data and lessons learned from the pilot were captured in a collaboration and learning document.
- › **Unequal contribution from private sector partners:** While Caltech has consistently delivered on its pledge to act as PUA's technical partner and PSA's lead investor, Heineken Timor-Leste has faced challenges that limited its contribution to the partnership. Caltech is on track to achieve the funding and in-kind targets it had formulated in 2019 and has shown substantial progress towards creating Timor-Leste's first integrated plastic recycling facility. Meanwhile, Heineken's revenue fell during the COVID-19 pandemic and the group has not been able to invest in circular economy solutions as initially envisioned by the PSA. Heineken's local business unit went through significant restructuring to maintain operation despite its financial difficulties and is still working to get back to 2019 sales levels and investment capacity – which were used as a basis to establish PUA's private sector leverage commitments but will not materialize within PUA's timeline. However, Heineken Timor-Leste recently started reinvesting in their commitments and contributions to the environment of Timor-Leste. In collaboration with the State of Secretary for the Environment, Heineken will fund a year-long clean-up campaign in one of Dili's tourist sites with a budget of USD \$10,000.
- › **Lack of local expertise to implement Timor-Leste's first plastic asphalt project:** Repeated competitive tenders issued by Mercy Corps for procuring road paving services incorporating plastic waste were unsuccessful. The conclusion of multiple bilateral engagements with local actors and consultations with international stakeholders indicate that the expertise required in the country is limited and the cost of such a project is higher than initially estimated. The recommendation for future programming is to create ownership and interest within relevant government agencies and to initiate a pilot using international expertise.
- › **Awareness Raising and Demand Generation needs to be embedded within the future circular economy program:** While PUA activities targeted the establishment of markets and strengthening the supply chain for recycled products, the activity received multiple recommendations regarding integrating demand generation and consumer awareness activities. Although PUA indirectly supports these demand generation activities, Mercy Corps implemented complementary programs funded by KOICA and the EU. However, additional investment on the demand side of recycled plastic would have further bolstered the impact. The recommendation for future programming is to develop an integrated activity package including strengthening and improving supply, demand and enabling environment activities.

Private Sector Leverage

Caltech	
Period	Aug 2019 – Sep 2022
Research and Development	32,713.82
Equipment/Machineries	723,799.32
Maintenance	940.25
Materials and Consumables	39,884.19
Labor	183,717.03
Raw materials	2,702.70
Waste Transfer Station	7,862.66
Others	2,250.00
TOTAL	\$ 993,869.97



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About Mercy Corps

Mercy Corps is a leading global organization powered by the belief that a better world is possible. In disaster, in hardship, in more than 40 countries around the world, we partner to put bold solutions into action — helping people triumph over adversity and build stronger communities from within. Now, and for the future.



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